

Beyond the chest film: Real-time point-of-care ultrasound for etiologic mapping of acute dyspnea in the emergency department

Akheela singh D¹, Neeraj Tripathi²
^{1,2} Consultant, Octvia Hospitals, Varanasi

Date of submission: 07-01-2026

Date of Review: 16-01-2026

Date of acceptance: 27-03-2026

Corresponding Author: Dr Neeraj Tripathi

Conflict of interest: Nil

Abstract

Background: Acute dyspnea is a common emergency presentation requiring rapid identification of the underlying cause. Chest X-ray is routinely used, but bedside point-of-care ultrasound (POCUS) may provide faster and more accurate etiological diagnosis.

Methods: A prospective diagnostic accuracy study was conducted in the department of Emergency Medicine, Octvia Hospitals, Varanasi, from November 2025 to December 2025. Adult patients presenting with non-traumatic acute dyspnea were enrolled consecutively. All patients underwent bedside POCUS and chest X-ray, and findings were compared with the final clinical diagnosis. Sensitivity, specificity, predictive values, and overall diagnostic accuracy were calculated.

Results: POCUS showed higher overall diagnostic accuracy than chest X-ray in identifying the cause of dyspnea. It performed particularly well in pulmonary edema, pleural effusion, and pneumothorax, while also providing rapid bedside information during initial emergency assessment. These observations are in agreement with recent studies reporting that lung or combined heart–lung ultrasound improves accuracy and time to diagnosis in acute dyspnea.

Conclusion: POCUS was an effective early diagnostic modality in emergency dyspnea and outperformed chest X-ray for several common conditions. Incorporating structured POCUS protocols into emergency practice may improve timely diagnosis and guide early treatment decisions.

Key words: Point-of-care ultrasound, Acute dyspnea, Emergency department, Chest X-ray, Diagnostic accuracy

This is an open-access journal, and articles are distributed under the terms of the Creative Commons Attribution License CC-BY 4.0. (<https://creativecommons.org/licenses/by/4.0/>) which permits unrestricted use, distribution, and reproduction in any medium, provided the original authors and source are credited. The views expressed in this article are those of the authors and do not necessarily reflect the official policy or position of the journal, its editorial board, or the publisher. The journal does not assume any responsibility for the accuracy or completeness of the information provided.

Introduction:

Acute dyspnea is a frequent and high-risk presentation in the emergency department, requiring rapid differentiation among cardiac, pulmonary, and other life-threatening causes. Conventional evaluation with clinical examination and chest X-ray may be time-consuming and occasionally inconclusive, particularly in overcrowded emergency settings. Point-of-care ultrasound (POCUS), integrating lung and focused cardiac assessment at the bedside, has emerged as a rapid, radiation-free tool that can improve early etiological diagnosis and shorten decision-making time in dyspneic patients [1]. Recent evidence has shown that POCUS demonstrates high sensitivity and specificity for common causes such as acute heart failure, pneumonia, pneumothorax, and obstructive airway disease, with good concordance with the final clinical diagnosis [2]. Further studies also support its feasibility, diagnostic contribution, and growing role in the evaluation of acute non-traumatic dyspnea across emergency care settings [3]. The aim of the study is to assess the diagnostic accuracy of POCUS in patients presenting with emergency dyspnea, in comparison with chest X-ray.

Methods:

This prospective diagnostic accuracy study was conducted in the department of Emergency Medicine

at Octvia Hospitals, Varanasi, over a period of four months from November 2025 to December 2025. The study included adult patients presenting to the emergency department with acute dyspnea of non-traumatic origin. Patients aged 18 years and above who presented with shortness of breath of recent onset and who were clinically stable enough to undergo bedside imaging were enrolled consecutively after obtaining written informed consent from the patient or from an appropriate legally authorized representative when required. Patients with traumatic dyspnea, those requiring immediate life-saving intervention that precluded ultrasound examination, those who refused consent, and those with known pregnancy or conditions in which chest imaging or study participation was deemed inappropriate were excluded. A predesigned structured proforma was used to collect demographic details, clinical history, comorbidities, vital signs, oxygen saturation, respiratory examination findings, provisional clinical diagnosis, and relevant emergency investigations. The study protocol was approved by the Institutional Ethics Committee before initiation, and confidentiality of patient information was maintained throughout the study period.

After initial clinical assessment and stabilization, each enrolled patient underwent POCUS at the

bedside by the treating emergency physician. The POCUS examination included a standardized lung ultrasound protocol with assessment of anterior, lateral, and posterior lung zones bilaterally for the presence of A-lines, B-lines, lung sliding, pleural effusion, consolidation, shred sign, dynamic air bronchograms, and pneumothorax signs. Focused cardiac ultrasound was also performed whenever indicated to assess gross left ventricular systolic function, chamber enlargement, pericardial effusion, right ventricular strain, and inferior vena cava diameter and collapsibility. The POCUS findings were recorded immediately on the study proforma, and a sonographic diagnosis was assigned based on predefined criteria for common causes of dyspnea such as acute cardiogenic pulmonary edema, pneumonia, pleural effusion, pneumothorax, chronic obstructive airway disease, pulmonary embolism suspicion, or mixed pathology. Following the ultrasound examination, all patients underwent chest X-ray as per emergency department protocol. Chest radiographs were interpreted by the concerned clinician and radiologist blinded, as far as feasible, to the final composite diagnosis. Additional investigations such as electrocardiography, arterial blood gas analysis, complete blood counts, serum biochemistry, cardiac biomarkers, D-dimer, computed tomography, or echocardiography were performed whenever clinically indicated.

The final clinical diagnosis was established after considering the entire hospital course, response to treatment, laboratory parameters, radiological investigations, specialist opinion, and discharge diagnosis, and this was taken as the reference standard. The diagnostic accuracy of POCUS and chest X-ray was evaluated by comparing each modality against the final clinical diagnosis. For each etiology of dyspnea, 2×2 contingency tables were prepared to calculate sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy. Agreement between POCUS, chest X-ray, and final clinical diagnosis was also assessed. Data were entered in Microsoft Excel and analyzed using SPSS version 23.0. Continuous variables were expressed as mean ± SD or median with interquartile range, while categorical variables were presented as frequency and percentage. Chi-square or Fisher's exact test was applied, with $p < 0.05$ considered statistically significant.

Results:

Total 120 adults presenting with acute non-traumatic dyspnea were evaluated. The mean age of the participants was 56.8 ± 15.2 years, and male constituted 56.7%. The commonest final diagnoses were acute cardiogenic pulmonary edema (28.3%), pneumonia (24.2%), and acute exacerbation of COPD/asthma (20.0%). When compared with the final clinical diagnosis, POCUS showed superior

performance over chest X-ray in identifying the underlying etiology of dyspnea. POCUS achieved a correct etiological diagnosis in 86.7% of patients, whereas chest X-ray was correct in 70.0% of cases, and this difference was statistically significant ($\chi^2 = 9.41$, $p = 0.002$) as shown in Table 1. The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall diagnostic accuracy of POCUS were 88.3%, 91.1%, 89.7%, 90.0%, and 89.2% respectively, all of which were higher than chest X-ray. Table 2 further demonstrated that POCUS had better diagnostic agreement than chest X-ray for pulmonary edema, pleural effusion, and pneumothorax, with statistically significant superiority noted particularly for pulmonary edema and pneumothorax.

Discussion:

The present prospective study demonstrated that POCUS had higher diagnostic accuracy than chest X-ray in the evaluation of patients presenting with acute dyspnea in the emergency department. In our study, POCUS correctly identified the underlying etiology in a larger proportion of patients and showed better sensitivity, specificity, positive predictive value, and negative predictive value than chest radiography. This finding is consistent with recent evidence showing that bedside ultrasound can rapidly differentiate common causes of dyspnea such as acute heart failure, pneumonia, pleural effusion, and pneumothorax with high diagnostic yield. Baid et al. reported that POCUS served as an effective initial diagnostic tool in acute dyspnea and improved early etiological identification in emergency settings, supporting its role as a frontline imaging modality in time-sensitive patients [2]. A 2025 study by Yousef et al. also found ultrasound to be accurate in dyspneic patients when compared with radiological imaging, reinforcing the value of bedside sonography as a rapid diagnostic extension of clinical examination [4]. Our findings therefore support the view that POCUS is not merely an adjunct but a highly practical bedside investigation that can bridge the gap between initial clinical suspicion and definitive diagnosis in overcrowded emergency departments, where timely decision-making is crucial for appropriate treatment and triage [2, 4].

One of the important observations in the present study was the superior performance of POCUS in detecting acute cardiogenic pulmonary edema, pleural effusion, and pneumothorax. This is clinically understandable because ultrasound can directly demonstrate diffuse B-lines, pleural sliding, pleural fluid, and lung point signs, which may be missed or delayed on routine chest radiography, especially in unstable patients or those examined in the supine position. In our series, POCUS showed particularly better agreement with the final diagnosis for pulmonary edema and pneumothorax, and this

pattern has also been described in recent literature. A 2024 systematic review by Russell et al. evaluating lung ultrasound for acute heart failure reported strong diagnostic accuracy for identifying acute decompensated heart failure in urgent care settings, highlighting its utility in distinguishing cardiac from non-cardiac dyspnea [5]. Likewise, Taheri et al. in a 2025 systematic review and meta-analysis concluded that POCUS had meaningful overall diagnostic contribution in acute non-traumatic dyspnea, with especially supportive evidence for lung ultrasound in acute heart failure diagnosis [3]. These reports are in harmony with our findings and suggest that the strength of POCUS lies in rapid pattern recognition of major respiratory and cardiac causes at the bedside, allowing earlier targeted interventions such as diuretics, pleural drainage, ventilatory support, or urgent referral [3, 5].

Another relevant aspect of the present study was that POCUS outperformed chest X-ray as an early bedside modality, which is important in emergency medicine where delay in diagnosis may worsen outcomes. Chest radiography remains a commonly used investigation, but its interpretation may be less sensitive in early pulmonary edema, small pleural effusions, occult pneumothorax, or mixed pathologies. In contrast, POCUS can be performed immediately during the primary assessment and repeated dynamically during resuscitation or clinical deterioration. Recent studies have continued to emphasize this advantage. Ciumanghel et al. in 2025 described point-of-care lung ultrasound as a rapid and reliable diagnostic tool for emergency physicians dealing with acute dyspnea in high-volume emergency departments [6]. Similarly, Bjällmark et al. in 2025 evaluated combined heart and lung ultrasound and demonstrated its relevance for diagnostic accuracy and time to diagnosis when compared with standard emergency assessment [7]. The implication of our findings is that integrating lung and focused cardiac ultrasound into the diagnostic pathway may reduce dependence on delayed radiology, shorten time to etiological diagnosis, and improve bedside confidence in managing patients with complex or overlapping syndromes. This is particularly valuable in resource-constrained tertiary hospitals, where immediate access to advanced imaging may not always be possible and where a radiation-free repeatable tool offers substantial workflow benefits [6, 7].

The study findings should also be interpreted in light of practical and methodological considerations. The diagnostic yield of POCUS depends on operator training, adherence to a structured scanning protocol, and correlation with clinical findings. Nevertheless, even recent work suggests that useful diagnostic performance can be achieved by less experienced operators after focused training. O'Brien et al. in 2025 reported that novice-performed POCUS still

showed meaningful diagnostic accuracy for several causes of dyspnea, indicating that structured training can broaden its utility beyond expert sonographers [1]. Sharma et al. in 2025 also highlighted that bedside lung ultrasound, especially when integrated with other clinical parameters, can enhance diagnostic accuracy in dyspneic patients [8]. Thus, our results support the recommendation that emergency departments should increasingly adopt standardized POCUS protocols for acute dyspnea and include formal ultrasound training in emergency practice. Although chest X-ray remains useful and final clinical diagnosis should continue to be the reference standard, our study indicates that POCUS provides earlier and more accurate bedside information for several common etiologies of dyspnea. Larger multicentric studies with outcome-based endpoints such as time to treatment, hospital stay, ICU admission, and mortality would further clarify the full clinical impact of routine POCUS-guided evaluation in emergency dyspnea [1, 7, 8].

Conclusion: POCUS emerged as a rapid and clinically valuable bedside tool for evaluating acute dyspnea in the emergency department, showing better overall diagnostic performance than chest X-ray for common etiologies such as acute cardiogenic pulmonary edema, pleural effusion, and pneumothorax. In the present study, POCUS was useful as an early extension of clinical examination and supported faster targeted management in a high-acuity setting. However, the findings should be interpreted in light of certain limitations, including the single-center design, relatively short study period, possible operator dependency of ultrasound, and the potential for reduced generalizability to other institutions with different patient profiles or variable ultrasound expertise. In addition, mixed etiologies of dyspnea and the absence of advanced imaging in all patients might have influenced final diagnostic categorization. Larger multicentric studies are needed to validate these findings and evaluate outcome benefits such as reduced treatment delay, hospital stay, and mortality.

References

1. O'Brien J, Caja KR, Tabbut MP, Schrock JW. Novice point-of-care ultrasound for the assessment of acute dyspnea in the emergency department. *Int J Emerg Med.* 2025; 18(1): 204.
2. Baid H, Vempalli N, Kumar S, et al. Point of care ultrasound as initial diagnostic tool in acute dyspnea patients in the emergency department of a tertiary care center: diagnostic accuracy study. *Int J Emerg Med.* 2022; 15(1): 27.
3. Taheri O, Samain J, Mauny F, Puyraveau M, Desmettre T, Marx T. Contribution of point-of-care ultrasound in the prehospital management of patients with non-trauma acute dyspnea: a systematic review and meta-analysis. *Eur J Emerg Med.* 2025; 32(2): 87 – 99.

4. Yousef MS, Al Azizi HM, Fouad MM. Point of care ultrasound as a bedside diagnostic tool in acute dyspnea patients in emergency department for timely management. *Respir Med.* 2025; 250: 108500.
5. Russell FM, Harrison NE, Hobson O, et al. Diagnostic accuracy of prehospital lung ultrasound for acute decompensated heart failure: A systematic review and Meta-analysis. *Am J Emerg Med.* 2024; 80: 91 – 8.
6. Ciumanghel I, Barbuta E, Ciumanghel AI, Buzincu I, Grigorasi G, Cimpoesu D. Point-of-care lung ultrasound - a rapid and reliable diagnostic tool for emergency physicians treating patients with acute dyspnea in high-volume emergency departments. *Emerg Radiol.* 2025; 32(3): 329 – 38.
7. Bjällmark A, Hummel G, Shahgaldi K. Diagnostic value of combined heart and lung ultrasound in emergency department patients with dyspnea. *Clin Physiol Funct Imaging.* 2025; 45(3): e70009.
8. Sharma A, Kaeley N, Aravindan N, Datta SS, Vasisht S. Using Lung Ultrasound Combined With N-terminal Pro-brain Natriuretic Peptide to Differentiate Acute Heart Failure From Chronic Obstructive Pulmonary Disease and Asthma in Emergency Department Patients Experiencing Acute Shortness of Breath. *Cureus.* 2025; 17(1): e77171.

Table 1: Comparison of diagnostic performance of POCUS and chest X-ray against final clinical diagnosis

Parameter	POCUS	Chest X-ray
Correct etiological diagnosis, n (%)	104 (86.7)	84 (70.0)
Sensitivity (%)	88.3	72.5
Specificity (%)	91.1	81.4
Positive predictive value (%)	89.7	75
Negative predictive value (%)	90	79.2
Overall diagnostic accuracy (%)	89.2	76.7
Statistical analysis: Chi-square = 9.41; p = 0.002		

Table 2: Agreement of POCUS and chest X-ray with final clinical diagnosis for selected etiologies

Diagnosis	Correctly identified n (%)		p value
	POCUS	Chest X-ray	
Acute pulmonary edema (n = 34)	31 (91.2)	25 (73.5)	0.048
Pneumonia (n = 29)	24 (82.8)	21 (72.4)	0.317
Pleural effusion (n = 13)	12 (92.3)	10 (76.9)	0.281
Pneumothorax (n = 8)	8 (100)	5 (62.5)	0.038
COPD / asthma (n = 24)	19 (79.2)	15 (62.5)	0.193